PATENT SPECIFICATION (11) 1 423 563

1 423 563

(21) Application No. 10027/73 (22) Filed 1 March 1973 (19)

(31) Convention Application Nos. 2 209 805 (32) Filed 1 March 1972
2 209 848 1 March 1972
2 209 868 1 March 1972 in

(33) Germany (DT)

(44) Complete Specification published 4 Feb. 1976

(51) INT. CL.² H01J 61/24

(52) Index at acceptance

H1D 12A 12B13Y 12B1 12B2 12B47Y 12B4 5C2 5P3 9C2 9CY 9FX 9FY 9H 9Y

(54) HIGH PRESSURE METAL VAPOUR DISCHARGE LAMP

(71) We, PATENT-TREUHAND-GESELLSCHAFT FUR ELEKTRISCHE GLUHLAMPEN m.b.H., of 1 Hellabrunner Strasse, 8 Munchen 90, Federal Republic of Germany, a German Body Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a high pressure metal vapour discharge lamp, preferably a high pressure sodium vapour discharge lamp comprising a cylindrical discharge vessel or arc tube of refractory, light-transmissive material, preferably of polycrystalline alumina, which is hermetically sealed at each end. One of the components of the seal is an annular member of ceramic material which fits into the end of the arc tube and has a hollow lead, preferably of niobium, sealed internally thereof, said annular member being connected to the arc tube by sintering or by a glass or metal solder.

It is already known to seal the arc tube by means of an annular ceramic member (German Offenlegunsschrift No. 1 471 379). Furthermore, it is known to provide another annular member which is pressed as a lid from outside against the ends of the discharge tube (German Offenlegungsschrift No. 1 639 086). However, the service life of such seals may be insuffiencient for practical purposes, depending on the material used and the sealing techniques applied respectively. After long periods of operation, strains may occur in the arc tube which lead to cracks. Moreover, the seals are mostly very complex or expensive.

It is further well known to design the lead of this type of lamp, at least at one end of the lamp, as an elongated tube through which both exhaustion and introduction of the filler, for instance, sodium or sodium amalgam, is effected (British Patent No. 1 150 262). It is also known to dispose sodium within the lamp, for instance, behind the filament coil (Swiss Patent No. 498 486). Furthermore, it is known that sodium is lost during lamp operation, for example, by clean-up. In order to reduce clean-up, a suitable metal, for example such as yttrium, cerium or the like, was additionally introduced into the lamp and expecetd to react with the oxygen present in the lamp (French Patent No. 1 562 159). It is also known to dispose sodium amalgam in the exhaust tube and to cover the exhaust port with a grid whereby the sodium is subsequently applied to the lamp by vapourisation (Japanese utility model 44-9815).

According to the invention, there is provided a high pressure metal vapour discharge lamp comprising an arc tube, an annular member sealed into one end of the arc tube, and a hollow lead hermetically sealed into the annular member and having an enlarged section outside the arc tube, the enlarged section of said hollow lead containing a body having capillary interstices which contain the metal or an alloy of the metal, provided as filling, and the interior of the hollow lead communicating with the interior of the arc tube only by means of a small aperture.

The hermetic closure of the enlarged section of the tubular leatd may be constituted by at least one platelet or cover which is welded or soldered thereto over a feed opening in said enlarged section. The diameter of the feed opening is preferably less than 2 mm. The body with capillary interstices may comprise a filament coil with its turns abutting the wall of the enlarged section of the hollow lead or a helix. However, the body may also be composed of wool of refractory material, such as tungsten wool, which fills in the enlarged section of the hollow lead or it may be formed of a porous sintered body, preferably of tungsten, or of a loose bulk of granules of refractory material, in which case the enlarged section of the tubular lead has to be closed off from the lamp interior, possibly by a mesh. Advantageously, the body with capillary interstices comprises metallic components which cause reduction of the temperature dependence

characteristic of the metal vapour pressure by binding the sodium amalgam.

The length of the annular member may be at least half and not more than three times its largest outer diameter, the inner diameter of the annular member being constant at least across that section to which the hollow lead is sealed, and the outer diameter of the end facing the discharge space is reduced over at most two thirds of the length of the annular member. It is advantageous if the inner diameter of the free end of the annular member facing the discharge space varies relative to that section to which the hollow lead is sealed, and if the outer diameter of the end of the annular member facing the discharge space is reduced at most over half the length of said member. Moreover, it may be suitable to provide, in the external cylindrical section of the annular member, at least one, if possible two, annular grooves. According to one embodiment of the invention, the end of the annular member of reduced outer diameter is not sealed to the arc tube.

The lamp, in accordance with the invention can be produced by both ends of the arc tube being simultaneously sealed in a single working step in vacuum to sealing portions without exhaust stems and provided with hermetically sealed leads. At least one of the seal portions may include a hollow lead, the end thereof facing the discharge space being provided with an opening, and its other end being closed off by a metal lid in which an aperture is formed under an inert gas at atmospheric pressure. The metal or an alloy of the metal, preferably sodium amalgam, provided as the filler may be introduced through this exetrnal aperture, the inert gas pumped off, and the external aperture closed by welding or preferably soldering without deformation subsequent to filling with the basic gas, preferably xenon.

The invention will now be described in greater detail, by way of example, with reference to the drawings, in which:—

Figure 1 shows a lamp according to one embodiment of the invention with one lead enlarged to form a projection; and

Figure 2 shows another exemplary embodiment of the invention.

In each of these two exemplary embodiments of the invention, both ends of the lamp are sealed simultaneously. However, as illustrated in Figures 1 and 2, the end A of each lamp is shown in a condition prior to sealing and the other end B is shown in sealed condition.

In the drawings, 1 designates an arc tube of polycrystalline alumina. Each of two rings 2 is made of the same material and, at each end, encompasses a hollow lead 3 or 3' of niobium. Apart from one of the two rings 2, each end of the lamp is additionally provided with an end cap 5 of niobium to which the lead 3 or 3' is bonded by solder 4. Interposed between front surface of ring 2 and end cap 5 is a ring 6 of glass solder. The glass solder 6 which becomes fluid during sealing, flows into the existing cavities and binds ring 2 to the arc tube 1 and to lead 3 or 3' as well as to end cap 5 so that a hermetic sealing of a ring 2 with the other lamp parts is formed at each end of the arc tube.

Lead 3 or 3' carries a core rod 7 and filament coil 8. Lead 3 is in communication with the interior of the arc tube via a small aperture 9. The lead 3 is enlarged at its outer end to form a projection 10 and is closed off by lid 11 save for a small aperture 12 of 1.9 mm. Aperture 12 is closed by two titanium platelets 13 of 140 μ thickness each, and by a molybdenum platelet 14 of 80 μ thickness by fusing the titanium platelets by means of resistance heating. Alternatively, the platelets 13 may be soldered to the projetcion and over the region of the aperture 12. Aperture 12 may be provided in the centre or at the side of projection 10. Projection 10 which has a volume of 70 mm^3, contains sodium amalgam 15 and a filament coil 16 with capillary interstices which ensures continuous dosed supply of sodium to the discharge.

The holow lead 3' is closed off from the lamp interior by three stacked discs 17 which are peripherally fused to the lead, a titanium disc of 0.2 mm thickness being embedded between two discs of niobium of 0.1 mm thickness. A metal support 18 welded to the end portion of lead 3, 3' in the vicinity of the electrode is used for support of ring 2 prior to sealing.

In Figure 2 the same parts are given the same reference numerals.

Annular member 2 has a length of 8 mm, its largest outer diameter is about 7.8 mm. Annular grooves 19 are provided in the external cylindrical section of member 2 and have a depth of 1 mm and are formed so that the mutual spacing of grooves and the spacing from groove to border of the cylindrical section of member 2 is in each case 1 mm. This design of member 2 ensures that possibly existing gas bubbles are pressed into the grooves during sealing so as to render possible a bubble-free solder seal.

The end of the member 2 is tapered towards the lamp interior while the inner diameter is maintained constant. The taper of the outer diameter extends through 3 mm of length of member 2 so that end 20 freely projects into the discharge space. This design of the end of the annular member also prevents an electrical connection from being established between seal portion 21 and lead 3 or 3' by condensed residues of the metal used as the filler and prevents the arc after ignition from initially striking in this place

until the electrical connection is interrupted or the metal film has vapourised and the arc flashes over to the electrode.

The power input of the lamp is 400 W; it is filled with xenon of 20 Torr as the basic gas and with 100 mg of sodium amalgam. The diameter of the arc tube is 7.9 mm, the electrode spacing 84 mm.

The location of the metal provided as filler for instance, sodium amalgam, in accordance with the invention affords several substantial advantages. Inter alia the amount of sodium amalgam introduced may be much larger than in known lamps; 100 mg or more may be used without causing unstable operating conditions in case of sudden overloads or in the run-up period of the lamp due to excess vapourization whereby the lamp extinguishes. This is achieved by the insertion into the projection 10 of a body having capillary interstices which maintain the fluid amalgam by capillary forces substantially within the projection.

The possibility of introducing a large amount of sodium without drawback is a means of reducing the rise of operating voltage during the lamp life as far as this rise is caused by the loss of sodium.

However, maintenance of the amalgam in the projection 10 is also of favourable influence when the rise of operating voltage is due to heat. An increase of the arc tube temperature in the vicinity of the electrodes due to a blackening of the electrode spaces and due to a variation of the emission capacity of the electrodes results in a more powerful increase of vapour pressure, and consequently, of operating voltage when locating the amalgam immediately behind the electrodes ("internal amalgam") in contrast to a location in the projection 10 ("external amalgam").

Moreover, it was found that the increase of operating voltage in case of overload is less high in lamps with an external amalgam than in lamps with an internal amalgam. When the body with capillary interstices contains metallic components which suitably bind the sodium amalgam as a function of temperature, it is possible to obtain a further flattening of the characteristic in case of thermal or electric load fluctuations.

WHAT WE CLAIM IS:—

1. A high pressure metal vapour discharge lamp comprising an arc tube, an annular member sealed into one end of the arc tube, and a hollow lead hermetically sealed into the annular member and having an enlarged section outside the arc tube, the enlarged section of said hollow lead containing a body having capillary interstices which contain the metal or an alloy of the metal, provided as filling, and the interior of the hollow lead communicating with the interior of the arc tube only by means of a small aperture.

2. A high pressure metal vapour discharge lamp according to claim 1, wherein the hermetic closure of the enlarged section of the hollow lead is constituted by at least one platelet which is welded or soldered thereto over a feed opening in said enlarged section.

3. A high pressure metal vapour discharge lamp according to claim 2, wherein the diameter of the feed opening is less than 2 mm.

4. A high pressure metal vapour dischage lamp according to any preceding claim, wherein the body with capillary interstices is a filament coil with its turns abutting the wall of the enlarged section of the hollow lead.

5. A high pressure metal vapour discharge lamp according to any one of claims 1 to 3, wherein the body with capillary interstices is a helix.

6. A high pressure metal vapour discharge lamp according to any one of claims 1 to 3, wherein the body with capillary interstices is composed of wool of refractory material which fills in the enlarged section of the hollow lead.

7. A high pressure metal vapour discharge lamp according to claim 6, wherein the body with capillary interstices is composed of tungsten wool.

8. A high pressure metal vapour discharge lamp according to any one of claims 1 to 3, wherein the body with capillary interstices is composed of a porous sintered body.

9. A high pressure metal vapour discharge lamp according to claim 8, wherein the body is composed of tungsten.

10. A high pressure metal vapour discharge lamp according to any one of claims 1 to 3, wherein the body with capillary interstices is a loose bulk of granules of refractory material.

11. A high pressure metal vapour discharge lamp according to any preceding claim, wherein the body with capillary interstices comprises metallic components which cause reduction of the temperature dependence characteristics of the metal vapour pressure by binding of the sodium amalgam.

12. A high pressure metal vapour discharge lamp according to any preceding claim, wherein the length of the annular member is at least half and not more than three times its largest outer diameter, wherein the inner diameter of the annular member is constant at least across that section to which the hollow lead is sealed, and wherein the outer diameter of the end facing the discharge space is reduced across not more than two thirds of the length of the annular member.

13. A high pressure metal vapour discharge lamp according to claim 12, wherein the inner diameter of the free end of the annular member facing the discharge space varies relative to that section to which the hollow lead is sealed.

14. A high pressure metal vapour discharge lamp according to claim 12 or claim 13, wherein the outer diameter of the end of the annular member facing the discharge space is reduced at most over half the length of said member.

15. A high pressure metal vapour discharge lamp according to any one of claims 12 to 14, wherein at least one annular groove is provided in the cylindrical section of the annular member.

16. A high pressure metal vapour discharge lamp according to claim 15, wherein the cylindrical section of the annular member is provided with two annular grooves.

17. A high pressure metal vapour discharge lamp according to any one of claims 12 to 16, wherein the end portion of the annular member of reduced outer diameter is not sealed to the arc tube.

18. A high pressure metal vapour discharge lamp according to any preceding claim, wherein the metal comprises sodium amalgam.

19. A method of producing a high pressure metal vapour discharge lamp according to any one of claims 1 to 18, wherein both ends of the arc tube are simultaneously sealed in a single working step in vacuo to sealing portions without exhaust stems but provided with hermetically sealed leads, at least one of the seal portions including a hollow lead, that end of the hollow lead facing the discharge space being provided with an opening and having its other end closed off by a metal cover in which an aperture is formed under an inert gas at atmospheric pressure, the metal or an alloy of the metal provided as the filler being introduced through said external aperture, the inert gas being pumped off and the external aperture being closed without deformation subsequent to filling with the basic gas.

20. A high pressure metal vapour discharge lamp substantially as described herein with reference to the accompanying drawings

For the Applicants,
J. F. WILLIAMS & CO.,
Chartered Patent Agents,
113 Kingsway,
London WC2B 6QP.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1976.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY
from which copies may be obtained.

1423563 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

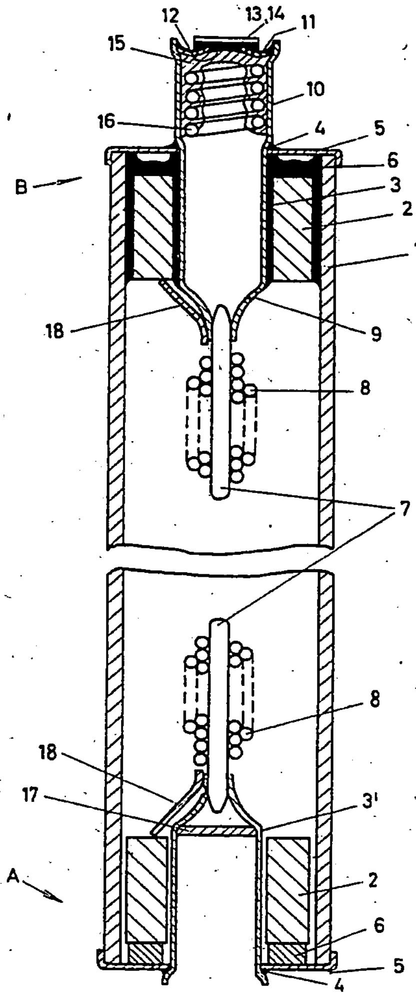

FIG. 1

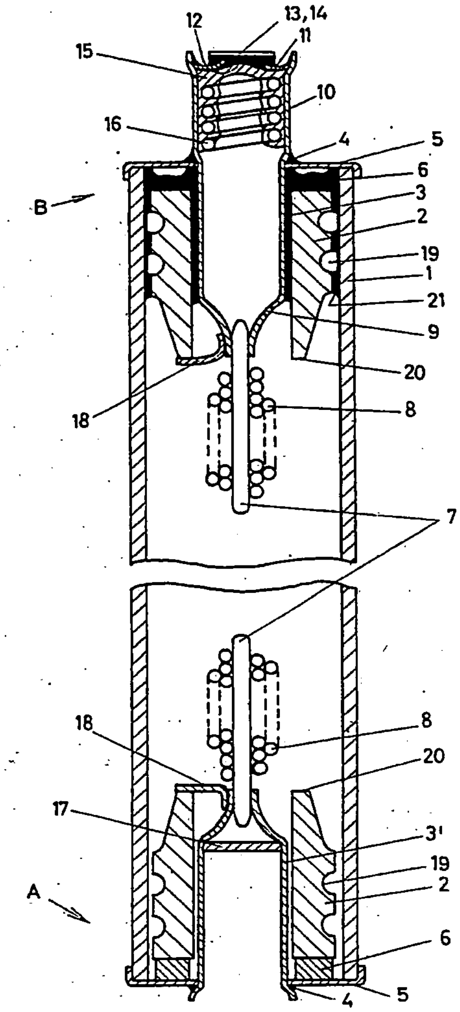

FIG. 2